Integrating ICZM and futures approaches in adapting to changing climates

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Abstract Climate change adaptation will be an imperative for twentyfirst century society. It will demand the effective pooling of scientific knowledge and socio-economic learning processes on a scale and at a pace not previously encountered. Within Europe, Integrated Coastal Zone Management (ICZM) is being promoted as a means of providing an integrating and strategic approach to facilitate the sustainable development of coastal areas as well as a platform for wide stakeholder engagement. ICZM, consequently, should be in a prime position to be able to facilitate the essential learning processes required for climate change adaptation. The paper explains key concepts and issues in using futures in climate change adaptation, especially addressing uncertainty, risk, mobilization of resources and actors, and decision-making processes. The paper then explores the role and value of futures within an ICZM context, highlighting the critical role of demonstration projects (such as the Interreg IVb IMCORE: Innovative Management for Europe's Changing Coastal Resource project) in evaluating the effectiveness, applicability and acceptance of these techniques.

Introduction

The relatively recent promotion of Integrated Coastal Zone Management (ICZM) within Europe following the EC Recommendation (2002/413/EC) has explicitly introduced the need for an integrated and strategic approach in order to ensure the sustainability of coastal areas. Given predictions of sea level rise, ICZM, alongside more conventional shoreline management programmes, has had to address the broader exigencies of the climate change agenda. Although it is not possible to divorce entirely the different dimensions of climate change, this paper primarily deals with adaptation to anticipated changes which might occur. The main aim of the paper is to discuss how futures studies – and scenarios in particular – can contribute to ICZM development and, in the context of climate change, to more robust and resilient climate change adaptation strategies for coastal areas. Climate change adaptation requires three parallel processes of contingency (understanding what we will do if x happens), optimisation (thinking strategically to ensure that we take can the best options and secure the best possible deal in terms of our wishes and resources) and heuristics or social learning (achieving cognitive appreciation and gains through participating in a stimulating and creative exercise).

This paper explores the role and value of futures to ICZM within the context of coastal climate change adaptation. It demonstrates the critical role of projects such as the Interreg IVb IMCORE (Innovative Management for Europe's Changing Coastal Resource) project in evaluating the effectiveness, applicability and acceptance of such techniques. The first section of the paper begins by explaining the context of ICZM development, outlining the need for new techniques such as futures to complement existing approaches. The second section then describes relevant concepts and techniques derived from the futures studies and foresight field. It includes a discussion on the conceptual and operational aspects of scenario building. The following section focuses on the use of futures and scenarios within climate change adaptation prior to a fourth section which discusses the overall advantages and limitations of scenarios within ICZM programmes. Finally, some conclusions are outlined in which the role of demonstration projects, such as IMCORE is highlighted.

Coastal Management Context

Whilst the management of coastal defence has played a central role in European coastal affairs, other sectoral initiatives, notably those emanating from the nature conservation and landscape protection fields, have dominated coastal management within many European countries until relatively recently (see for example, Pettit 1999 and Ballinger 1999; Williams 1992), particularly as a result of the sectoral evolution of legislation (Elliott *et al.* 1999). Within these, conservative, technocentric and ecocentric approaches to shoreline and coastal management have, unfortunately, pervaded most local coastal management (Ballinger *et al.* 2004; Nicholls and Klein 2005; French 2001). Hard systems thinking, with its reliance on simple cause-effect, linear predictive forecasting has also been a key characteristic. With little focus on the socio-economic environment, poor recognition of the linkages between physical, environmental and human systems, and the perpetuation of a development-defend cycle at local levels (Ballinger *et al.* 2002), this has contributed to the high vulnerability of much European coastal development to climate change impacts. However, the last couple of decades have witnessed major technological advances alongside more strategic and participatory approaches to coastal defence, particularly within the UK where shoreline management and extended cost-benefit analysis of coastal defence schemes have begun to address a wider range of environmental and human issues and needs (Townend 1992; Potts 1999; Cooper *et al.* 2002; O'Riordan and Ward 1997), partly in response to the increasing demands of the environmental impact assessment process. As Evans *et al.* (2004) note, such changes have occurred in parallel to international advances in the application of new technology related to integrated analysis and planning of the water sector. Within this context, the recent application of the DP-S-IR (Drivers/Pressures-State-Impact/Response) framework has been instrumental in facilitating integrated environmental assessment, although Carr *et al.* (2007:544) suggest that DP-S-IR is unable to 'address the impact of aggregated, informal responses on the drivers and pressures related to environmental problems and sustainability challenges'.

Alongside the broadening scope of traditional coastal management sectors, ICZM has emerged as both a new concept and approach. ICZM, as promoted by the EC Recommendation (2002/413/EC), advocates a multisectoral, holistic approach, linked to the delivery of sustainable development and the need to embrace environmental, economic and societal aspects. The principles of ICZM exhorted by the EC Recommendation (2002/413/EC) also present challenges to conventional management approaches and are of interest in the context of futures. Particularly noteworthy are the requirement for long term and adaptive management approaches, which recognise the non-linearity of decision-making impacts as well as the need for full participation and stakeholder engagement in ICZM development. The new era of ICZM approaches acknowledge the limitations of solely predictive approaches and recognise the complex, interrelationships between physical and human systems, as exemplified by the current European Framework Programme (FP6) SPICOSA (Science and Policy Integration for Coastal System Assessment) project (Reis 2010). Given ICZM's focus on integration and sustainability, the ICZM community has begun to consider framing the ICZM process within the emerging concepts of sustainability science and the ecosystems approach (Cummins in press, Ballinger *et al*. 2008). Sustainability science, an approach which reflects an appreciation of the need to understand the complexity of dynamic interactions between nature and society, brings together established sciences in a multidisciplinary environment to address common policy problems (Swart *et al*. 2004; Kates *et al*. 2001). It also promotes participatory approaches, high social capital, and local knowledge 'soft' systems, including the co-production of knowledge through close collaboration between researchers, policy makers and practitioners. It is particularly relevant for addressing complex and cross-cutting, so-called 'wicked' (Jentoft and Chuenpagdee 2009), issues and uncertainties, such as those linked to climate change in coastal zones. Similarly, the ecosystem approach has moved away from a singular, reductionist approach to one which recognises the inter-relationships between physical and the human components of the ecosystem (Laffoley *et al*. 2004).

Whilst ICZM theory and policy suggest a paradigm shift in the approach to coastal management, in practice with no European statutory requirement for ICZM, national and local ICZM programmes are diverse and at varying stages of development (O'Hagan and Ballinger 2009). Given their contrasting objectives, often dependent on the focus and interests of the local actors, ICZM efforts are variable in the extent to which they reflect the new paradigm (Ballinger *et al*. 2008). However, whilst most attempt to deliver sustainability through wide stakeholder engagement, local ICZM initiatives are frequently beset by a range of issues including ones associated with institutional barriers, inadequate policy frameworks, informational obstacles and resources issues (Shipman and Stojanovic 2007; Stojanovic and Barker 2008). There is also a frequent deficit of stakeholder representatives from the business community, which can stultify local attempts to promote true sustainability (McGlashan 2003). The latter are particularly apparent within project-based ICZM, which pervades much local ICZM practice (O'Hagan and Ballinger in press).

Coastal Change and Needs

Much of the extensive low-lying and heavily urbanised coast of North West Europe is already at significant risk from flooding and coastal erosion, with some countries, such as England and Wales reporting extensive stretches of coast and communities at risk from such hazards (Burgess *et al.* 2005). However, as indicated above, some of this risk is as much related to inappropriate siting of development, through limited understanding of coastal processes and hazards, as to increased risks associated with climate change (Ballinger *et al.* 2004). Over the next century, however, such short-sightedness will become less viable. Recent reports, such as the State of the Coast Report by the European Environment Agency (2006) and the Stern Review on the Economics of Climate Change (2006), acknowledge that the prospect of climate change poses serious and potentially catastrophic implications for the future development of coastal areas and resources across Europe (Nicholls and Klein 2005; De Groot and Orford 2001). Within the North West European region, future relative sea level rise and possible changes in storminess make many coastal communities and much critical infrastructure, including ports, coastal defence structures and power stations, increasingly vulnerable to storm damage, flooding and erosion. However, it is not only the urban and industrialised coasts, such as the Severn and Thames Estuaries, which are vulnerable. The rural coastal regions with more limited economies, such as Northwest of Ireland and Western Brittany, are often even more highly dependent on access to coastal resources.

ICZM and Climate Change

Whilst ICZM has developed as a process and has been promoted at the European level, its focus has tended to remain outside that of traditional coastal defence and shoreline management. However, with its wide remit and systems approach, a number of ICZM initiatives have recognised the complex and interlinked challenges for coastal communities and sectors associated with climate change. This has resulted in the initiation of demonstration projects, such as the Interreg IVb IMCORE project. This is exploring and developing the potential of futures approaches within an ICZM and sustainability science framework, building on the experiences from the previous Interreg IIIb COREPOINT (Coastal Research and Policy Integration: http://corepoint.ucc.ie/) project and network. The IMCORE project (2008-2010) involves seventeen partners from across five Member States in a series of nine Expert Couplet Nodes (Cooper and Cummins 2009). These bring together local government authorities and research groups to enable close collaboration between coastal practitioners, policy makers and scientists (Table 1) at local levels. Intending to promote a transnational, innovative and sustainable approach to reducing the ecological, social and economic impacts of climate change on the coastal resources across the North West European region, the project local partners are supported by trans-national cooperation including the sharing of perspectives, experiences and approaches between couplets.

Table 1: Scenario typology (van Notten et al.)

Overarching themes	Scenario	Characteristics
A Project goal: exploration versus decision support	I	Inclusion of norms?; descriptive versus normative
	II	Vantage point: forecasting versus backcasting
	III	Subject: issue-based, area-base, institution-based
	IV	Time scale: long term versus short term
	V	Spatial scale: global/supranational versus national/local
B Process design: intuitive versus formal	VI	Data: qualitative versus quantitative
	VII	Method of data collection: participatory versus desk research
	VIII	Resources: extensive versus limited
	IX	Institutional conditions: open versus constrained
C Scenario content: complex versus simple	X	Temporal nature: clean versus snapshot
	XI	Variables: heterogenous versus homogenous
	XII	Dynamics: peripheral versus trend
	XIII	Level of deviation: alternative versus conventional
	XIV	Level of integration: high versus low

Source: van Notten *et al.* (2003: 426)

Futures and Foresight Approaches

Futures approaches are an assembly of theories, methods and tools that enhance individual and collective cognitive capacities to act in conditions of uncertainty. This section provides a brief introduction to futures, from theories to key concepts and methods.

Futures can be conceived of in different ways and with different lenses. At the core of most futures work is uncertainty and indeterminacy. As the future is not predetermined or given, possible futures might emerge from the interaction of the human agency of individuals who are continuously adjusting within their environments, seeking to realise their goals and optimising strategic options available to them. One of the early, foundational categorisations offered within the field was to differentiate between possible, probable and desirable futures. The first two terms reinforce a common perception (and a basic curiosity) that futures should be concerned with measuring probabilities. What level of probability can we ascribe to this particular future – expressed, ideally, as a percentage? For example, a statement could declare that there is an eighty per cent probability that this future (or scenario) will happen. Although intuitively individuals and organisations may well have a view of the most probable future, most futures work is not designed to achieve this type of outcome. Indeed, there is a significant critique of probabilistic futures or scenarios work for several reasons. This type of reasoning can establish or reinforce a soporific mindset that the organisation is planning for the one probable future. A great deal of scenarios work has explicitly avoided the probabilistic route to ensure that the implications of plural futures are considered. This approach is intended to avoid cognitive sclerosis, a 'condition' where people are less able to deal with discontinuity and adapt accordingly. The third category of 'desirable' futures brings in norms, values, beliefs and aspirations. Clearly, such aspects are important to ICZM in its attempt to provide adaptive and holistic management of coastal areas.

Engaging with probabilities is more closely aligned with predictive or forecasting approaches. There is a common perception (or misconception) that futures work is primarily concerned with prediction and forecasting. That is not the case. Although futures makes use of forecasts and projections, futurists are more concerned with the multiple possible futures that might emerge from the same context, thus challenging the traditional linear, predictive scenario approach commonly used by coastal practitioners and referred to above. Taking the case of demographic changes as an example which is relevant to the management of the coasts of North West Europe, there is an established framework for modelling and extrapolating population trends. In the absence of sudden, disruptive influences, demographic changes are relatively stable. It is a field in which predictive models are valued and routinely used. However, if we were to ask the questions, 'what impact might changing demographic patterns have on care services?' or 'what impact might changing demographics have on planning and the built environment?', an alternative set of methods needs to be used. Having demographic projections for various age cohorts would be an important data source but it would be only one type of input – amongst many – that would help to address a more complex type of inquiry.

The philosophical and methodological foundations of futures have been continuously re-visited since the middle of the twentieth century. Futures has generally followed broader philosophical and methodological debates within the sciences and socio-economic sciences over recent decades. As in related fields, futures work has explicitly or implicitly reflected the assumptions of particular paradigms. Voros (2008) uses an established typology of research paradigms (positivism, post-positivism, critical theory, constructivism and participatory) and traces a general shift within futures from the objectivist to the subjectivist. This mirrors the overall movement in socio-economic disciplines. The same author identifies four main purposes of these paradigms: 'prediction and control; critique and transformation (leading to emancipation); understanding and insight (leading to re-construction of prior constructions); and human flourishing (through political participation)' (Voros 2008:197).

A study completed for the Foundation for the Future, Seattle in 2007, 'State of Play in the Futures Field' (SOPIFF: www.thinkingfutures.net/sopiff) provides a very instructive overview of the central concepts, purposes and practices within futures. It employed the following metascanning categories to assess the material it surveyed: organisational type, social interests, methods, focal domains and capacity building and location. In terms of social interests, in order of diffusion of prevalence in the field, the most common are pragmatic (status quo/immediate), followed by progressive (innovative solutions) and civilisational (longer term). On the SOPIFF Slaughter (2008:913) comments that 'while this is an avowedly simple summary it fits into an overall picture in which the great majority being currently undertaken is largely conventional, short-term, pragmatic and therefore, to varying degrees, subordinated to the economic and political powers of the day. It will not be able to help society 'change course' or realise any of the 'alternative futures' that were so in vogue only a few years ago.

Drivers of change (or drivers) is an important term within the futures lexicon. Drivers are those forces or phenomena that have the potential to induce change within a given situation or system. There are various methods for classifying drivers, for example, PESTLE analysis; this consists of political, economic, social, technological, legal and environmental drivers (hence the PESTLE acronym). The scale and type of impact or change that drivers can facilitate varies considerably. Some drivers have a currency and meaning that can be applied very widely, and whose impacts may affect the lives of most people. For example, in one important governmental exercise conducted in the UK on drivers, globalisation and climate change were regarded as 'ring road' issues, which would have wide and deep significance for people's lives. In the context of ICZM, the identification and recognition of such underlying drivers is clearly important, linking with the DP-S-IR approach, previously mentioned.

Scenarios

Scenarios are special stories that portray plausible futures. One notable futures expert describes scenario building as 'a tool for ordering one's perceptions about alternative futures environments in which one's decisions might be played out' (Schwartz 1991:45). Scenarios can be very powerful tools to contemplate the range of possible futures that could develop from the influence of key drivers, events and issues. Although scenarios can take advantage of quantitative forecasts and projections, scenarios are not designed primarily to predict the future per se, but rather to develop capacity to consider a range of possible futures, developed from the interactions between important variables. As such, these methods have much to offer ICZM with its need to address interactions between complex systems and to provide direction for future management. Some scenario applications, however, do include forecasting techniques and forward-oriented, quantitative models.

The best known and most widely practised scenario technique is that development by Royal Dutch Shell/Global Business Network, based on 'intuitive logics'. The scenarios are constructed using what are considered to be the two most significant and uncertain driving forces that are relevant for the theme under consideration. The rationale or logic for those driving forces are revealed and located at opposing ends of axes. Typically, the scenarios are logically assembled on a 2x2 matrix, with the 'points' of two axes determining the essential character of the scenario. In his book, *The Art of the Long View,* Schwartz (1991) describes the technique and the art involving in cultivating its use. Millet (2003:18) calls this the 'gold standard of corporate scenario generation'. In accentuating the positive dimensions of the scenario technique, it has been commended for its fusion of technical sophistication and functionality with different audiences. One of the major criticisms levelled against the 2x2 technique is its reliance on just two driving forces to frame and reflect the uncertainties of possible future environments. The diffusion of the intuitive scenarios approach has tended to engender technique blindness. Over recent years, some interventions in the futures field have flagged the dangers of application uniformity and discussions on scenario methods have been assisted by fresh overviews of typologies and techniques (for example, Bishop *et al*. 2007; van Notten *et al*. 2003; European Environment Agency 2009).

In the typology offered by van Notten *et al*. (2003), there are three overarching themes for the scenarios (Table 2). The first theme concerns the nature of the project goal: either exploration or decision support. Within exploratory processes, the learning experience that ensues from challenging and conversing within a group context can be as important as or more important than a formal, tangible product, such as published scenarios. Clearly, this could be beneficial to ICZM, particularly given the diverse stakeholder community involved in the ICZM process. A descriptive, exploratory process will begin by unfolding potential future events and changes based on our understanding of present situations, trends and possibilities. Depending on the technique deployed, the result of this type of exercise might be a limited number of scenarios that convey how those main variables might play out and interact over time. A normative approach, as opposed to the descriptive approach, will begin with the type of future in which the subject's values are realised. Generally, this is the preferred future for the company, organisation, country or policy sector.

Table 2: Expert Couplets partners in the IMCORE project.

Local government group	Research group(s)
Cork County Council	Coastal & Marine Resources Centre, University College Cork
Donegal County Council	Centre for Coastal & Marine Research, University of Ulster
Aberdeen City Council	Aberdeen Institute for Coastal Science and Management, Aberdeen University
Sefton Council	Edgehill University
Durham Council	Envision, Newcastle University
Government Office (East of England) & Colne Estuary Partnership	CoastNet, UK
Severn Estuary Partnership (SEP)	Cardiff and Glamorgan Universities
Intermunicipal Syndicate for Planning in the Gulf of Morbhian (SIAGM)	Centre for Maritime Law and Economy, University of Western Brittany
MDK – Coastal division	Maritime Institute, University of Gent

The second overarching theme identified in the scenario typology outlined by Van Notten *et al*. (2003) is process design. Of particular importance in this context is the selection of methods that are appropriate for the purpose and the specific project, clearly an important aspect for ICZM application, given the wide range of types of ICZM activities within Europe. The fundamental choice of quantitative versus qualitative data forms an important aspect of process design. Some scenario exercises combine both qualitative, intuitive approaches and quantitative, formal approaches.

The third overarching theme in the typology offered by van Notten *et al.* (2003) concerns scenario content. For example, it probes the extent to which the dynamics of the scenario reflect a continuation of trends versus a more discontinuous situation in which there are breaks with current trends (peripheral versus trend).

The typology of Börjeson *et al.* (2006) is based on the earlier distinction between probable, possible and preferable futures. In this typology, scenarios are divided into the predictive (that is, oriented towards forecasting specific futures and the scenarios which are traditionally most commonly employed within shoreline management and ICZM), the explorative (that is, seeking to understand the plurality of possibilities that may emerge from the present day context and our understanding of it), and the normative (that is, what is a desirable future state for the people viewing it – the aspiration). Within their categories, they classify scenario techniques according to their purpose: the first is generating techniques (for collecting ideas, knowledge and views regarding aspects of future). The second purpose is integrative and the techniques integrate parts into a whole using models. The third purpose is to generate consistency and thus the technique seeks to ensure consistency among different forecasts.

Bishop *et al.* (2007) provide a more comprehensive view of scenario techniques and their characteristics. They capture eight types of scenario techniques all of which could be applied within the ICZM context, dependent on capacity and the overall objectives of the ICZM initiative or programme. The first group is based on judgement of some type, which might or might not have more robust or formalised underpinning methodologies; examples included in this category are genius forecasting, visualization, role playing, and the Coates and Jarratt technique (a judgemental scenario technique that identifies the domain, time frame and conditions within the domain; the scenario themes 'illustrate the most significant kinds of potential future developments' (Coates 2000). The second group is constructed around a baseline or expected future, thus differing to the techniques that posit multiple possible futures. Extrapolation of existing trends is one common mode of producing this type of scenario. (The examples given here are trend extrapolation, Manoa systems scenarios developed at the University of Hawaii by Wendy Schultz and others to explore inter-linkages between trends, and trend impact analysis). The elaboration of fixed scenarios constitutes the third group, with the emphasis placed on probing the implications of a given set of scenarios. Participants probe the ramifications of provided scenario narratives but they do not play a role in their development. Incasting and the SRI techniques are examples in this category. The fourth group consists of techniques that work on event sequences (example techniques: probability trees, sociovision, divergence mapping). In the fifth group of techniques, backcasting (for example, horizon mission methodology; Impact of Future Technologies; future mapping), participants work backwards from a more visionary form of scenario, which might convey some desirable future that is some distance away from the reality of the present. The sixth group of techniques, dimension of uncertainty (morphological analysis, field anomaly relaxation), focus on various sources of uncertainty as foundations for scenarios. The seventh group consists of cross-impact analysis, for example, SMIC-PROB-EXPERT (Cross-Impact Matrices and Systems). Such methods try to 'evaluate changes in the probabilities of a series of events following the occurrence of one or several such events'(LIPSOR, undated). The eighth and final group consists of modelling techniques, such as trend impact analysis, sensitivity analysis, and dynamic scenarios.

Issues of Scale and Granularity

Scales can vary enormously in scenarios work. Two important dimensions of scale relate to the issue or theme under consideration and the geographical boundaries of the application, both relevant to ICZM development within Europe. In view of the stated purpose of most futures work of dealing with uncertainty, the capacity to adopt macro-level perspectives is often invaluable as a way of surveying the bigger picture, especially at a strategic level. Even though many scenario users will be aware of the need for such big picture considerations, many will need some adjustment of focus to render the scenario lenses applicable on smaller canvasses. For example, the global scenarios produced by Royal Dutch Shell are aimed quite high at the corporate level. Companies within Shell Group undertake additional or intermediate steps to make them applicable to their particular contexts and product areas. In spatial terms, the integration of multiple levels – from the global to the local – has been problematic for most scenario exercises although some recent examples have sought more purposefully to combine global, top-down elements with more localised, bottom-up elements (van Notten *et al.* 2003:431). The appropriate scaling of scenarios helps in achieving 'granularity', in which participants gain a more nuanced appreciation of how the scenario could impact upon their areas of interest. Clearly, such granularity is important for the most predominant, locally based, ICZM initiatives.

Scenarios for Climate Change Adaptation

Scenarios have been used in climate change studies since the late 1970s, and their use has spread to several aspects of the field including greenhouse gas emissions scenarios, climate scenarios, land use scenarios, socio-economic scenarios, adaptation scenarios, policy scenarios (Hulme and Dessai 2008a:1) and, rarely, scenarios specific to ICZM development (for example, Kannen 2004). The principles of scenario thinking – especially in stimulating strategic thinking – have been transposed from the governmental and corporate worlds to climate change studies. Even though futures methods have been adopted by climate change studies, some futurists believe that futures has a far greater role to play in global environmental sustainability than hitherto has been the case. Slaughter (2008:913) is critical and offers a mini-manifesto for avoiding cataclysmic consequences: 'Overall, humanity is now set on an "overshoot and collapse" trajectory and the sum total of futures and foresight work has thus far had little impact ... If ever there was a

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time for the species to "wake up and pay attention" of the changes being inscribed ever more deeply upon its world, then that time is now. The most useful role for futures/foresight work is to assist in this process of "waking up" to humanity's self-constructed plight'.

Given the increased awareness of the need to mitigate and adapt to climate change, it might appear odd that there has not been a more intense exchange and collaboration between futurists and climate scientists. Nordlund (2008:875-6) notes that a greater engagement with futures thinking and methods would have had a beneficial impact in the IPCC's scenarios work:

> Futures research could have had a greater, beneficial impact on the IPCC work; 'as is well known, futures research focuses much attention on a study of the philosophical and methodological aspects of prediction and forecasting generally, as well as on more method-specific analyses of the use of causality, the set-up of scenarios, and the application of judgement methods in study socio-economic development etc. Taking into account this special expertise created by futures research, the contribution from futures science and individual futurists to the IPCC assessment studies could have been much greater than it appears to have been the case until now.

Despite this basic critique, there is a growing body of work around the use of scenarios in climate change strategies and policies – at many spatial levels. These levels range from the global, such as the IPCC scenarios, the European (for example, the work done by the European Environment Agency), the national (for example: UK Climate Impacts Programme 2000; Arnell *et al.* 2004; Nunneri *et al.* 2005; Evans *et al.* 2004), regional (for example, Holman *et al.* 2005a and b) and local. Indeed, a small number of coastally based projects have attempted downscaling of SRES scenarios at regional and local levels: (Nicholls *et al.* 2006; Holman *et al.* 2005a, 2005b; Andrews *et al.* 2005).

Types of Scenarios for Climate Change Adaptation

A number of scenario typologies have been offered. As in other sectors of application, van Notten *et al.* (2003) developed a typology that can provide a useful framework for climate change adaptation. For example, it can lend some practical assistance in discussing important project themes: project goal, process design and scenario content. The typology suggested by Börjeson *et al.* (2006) is an alternative framework for analysing climate change adaptation strategies. Their categorisation of predictive, explorative (or exploratory) and normative have a resonance in climate change scenarios literature and practice. Of all the areas of climate change in which scenarios have been used, adaptation is one of the most dynamic and contingent areas and one which is beginning to be explored within ICZM, through projects such as IMCORE and the UK government's Coastal Change Pathfinder project (Defra 2009). Conceived of in terms of conscious, anticipatory systems, adaptation necessarily includes assumptions about the reflexive capacity of societies to anticipate expected climatic changes. In addition to climate-human interactions (and anthropogenic influences) that create complex feedback loops, adaptation scenarios need to reflect the anticipatory human capacities to deal with expected changes. These involve active and pro-active adaptation strategies in addition to passive, reactive human behaviour. An amalgamation of predictive, exploratory and normative elements could be incorporated within a coherent scenario approach. The predictive element provides some of the best scientific attempts to estimate direct climate changes (expressed in ranges of temperatures, sea-level rises and so on, including their perceived secondary impacts, for example the UK government's UK Climate Projections – UKCP09 (UKCP09, undated)). The exploratory dimension provides a plurality of plausible alternative futures, in which active strategies to adapt (or not) have been pursued. The normative dimension, less prominent in the main literature, can also play an important role in opening possibility spaces. Again, since adaptation is a type of active strategy pursued by humans, the preferred future could be particularly important in illuminating pathways and decision points to achieve the desired state. Backcasting, a normative scenario technique which works 'backwards' from a normative future, could be effective in this regard.

Selecting Appropriate Scenario Methods for Climate Change Adaptation

Comprehensive adaptation scenarios will ideally have a combination of exploratory and predictive elements, although 'predictive' in this context consists of ranges based on scientific modelling (not a single, linear projection). Füssel (2007:265) emphasises the importance of accurate, predictive successes of scenarios in relation to adaptation to climate change: 'The effectiveness of pro-active adaptation to climate change often depends on the accuracy of regional climate and impact [scenarios]'. For ICZM, this is particularly important for predictions relating to relative sea level rise which indicate potential areas and sectors at risk from marine flooding and inundation.

Although scenario exercises culminate in products – the narrative accounts and other communicative devices – the learning and strategic dialogue that is at the heart of many scenario exercises is usually considered at least as important as the tangible outputs. Scenarios have been described as more of a participation sport than a spectator sport. This aspect has also been recognised within the environmental sciences community, where O'Neill *et al.* (2008) understood scenarios either as products or as social processes.

Some authors have highlighted the need for scenario evaluation in climate change studies. Hulme and Dessai (2008a) evaluate UK national climate scenarios in terms of predictive success, decision success (the extent to which good decisions have subsequently been made) and learning success (the extent of participation and learning). They draw parallels with the evaluation criteria of credibility, saliency and legitimacy described by Cash *et al.* (2003) in relation to science-policy interfaces. In using this framework within environmental scenarios, 'credibility is concerned with the scientific adequacy of the technical component of the scenarios, salience is concerned with the relevance of the scenarios to the needs of decision-makers and legitimacy is concerned with the process and transparency of the scenario design, construction and distribution' (Hulme and Dessai 2008b:56).

Van Vuuren and O'Neill (2006) and Pielke *et al.* (2008) evaluated IPCC's global emissions scenarios against observed emissions trends, whilst the IPCC's global temperature and sea-level rise scenarios have been evaluated by Rahmstorf *et al.* (2007) and Pielke (2008) against recent observations. Hulme and Dessai point to the difficulties of evaluating the predictive success of scenarios: long time scales are involved (compared, for example, to daily weather forecasting); good climate models do not necessarily equate to good climate scenarios (Hulme and Dessai 2008a:3). Nonetheless, their evaluation of recent trends in UK climate states that the actual data have fallen in the range of UK climate scenario projections (Hulme and Dessai 2008b).

Climate change adaptation is complex, connecting numerous environmental, economic and social issues, many of which are the concern of ICZM. At times there has been a tendency to portray the selection of methods as a binary choice between the quantitative and the qualitative. The traditions of individual disciplines and epistemic communities have consciously or unconsciously built barriers where bridges are needed. As van Notten *et al.* (2003:431) note, 'a combination of qualitative and quantitative elements can make a scenario more consistent and robust. A quantitative scenario can be enriched and its communicability enhanced with the help of qualitative information. Likewise, a qualitative scenario can be tested for plausibility and consistency through the quantification of information where possible. However the fusion of quantitative and qualitative data in scenarios remains a methodological challenge'. Whereas the traditional 2x2 scenario matrix technique has, by and large, consciously avoided including probabilistic information with scenarios, there are case in which probabilities might be useful. In a discussion on using probabilities with climate scenarios, Parson *et al.* (2007) note their utility where there are a small number of quantitative variables, and where there is a large potential user group. Probabilities are seen as less useful in more exploratory exercises, where complex narratives are designed to engender learning in the participating group.

In the first few decades since the development of futures studies there has been a heavy focus on using specialists in niche fields. Whereas this appears to be an appropriate approach where the theme is narrowly defined, in exercises that have a broader scope, including many coastal 'applications', there has been increasing recognition that the participatory gene pool should be much wider. Climate change adaptation is an area where the gene pool needs to be more broadly based than in many conventional technocratic exercises. In addition to environmental scientists, policy-makers (at several levels) and specialist consultants, stakeholders need to be actively engaged in the process. The IMCORE project, referred to earlier, is an attempt to gain wide participation of such stakeholders in adaptation planning for the coast. Civil society groups and businesses need to be part of the strategic conversation that will ultimately lead to explicit adaptation strategies (and tacit knowledge in anticipating change). Skill sets within environmental scenarios are broad, and will benefit from techniques and insights gained from futures and, more broadly, social science methods. Techniques such as stakeholder and envisioning workshops can sit alongside more solid desk research. The learning process – distributed through the local and regional context – is integral to adaptation scenarios. It entails cognitive galvanisation at several levels. The importance of the group learning process is often underestimated and 'the main impacts like raising awareness, policy-learning and reconsidering the validity of policy assumptions often result more from the process of developing scenarios than from the published record of their output disseminated after the analysis' (EEA2009:11).

Discussion

Coastal futures techniques are potentially significant and powerful tools for ICZM, particularly given the huge uncertainties associated with climate change in coastal areas. Not only do they facilitate a move away from total reliance on deterministic, linear predictions of future climate and coastal change, but they also enable coastal managers and communities of stakeholders to contemplate a range of possible futures emanating from consideration of a wide range of events and potential drivers (particularly through using approaches such as PESTLE, referred to above). Many potential drivers may be discounted or ignored within conventional coastal planning and management, particularly at local levels where the focus of so many ICZM initiatives tends to be on immediate problem solving. The wide canvas of futures' approaches, therefore, can facilitate 'holistic' coastal management which requires consideration of all elements of the coastal system and their interrelationships. The approach also assists in the adherence to allied principles, including those associated with the ecosystem approach and sustainable development, referred to earlier, ensuring consideration of possible changes in socio-economic coastal conditions as well as environmental change.

One of the key advantages of futures, and scenario building in particular, is the potential for enhancing stakeholder participation and capacity within ICZM efforts. Such techniques could 'open' the mindsets of those involved in ICZM to a wider range of plausible futures, enabling more creative thinking 'outside the box' of the traditional technocentric and ecocentric approaches to shoreline and coastal management, noted above. As Kok *et al.* (2006) have suggested, such techniques may also encourage more proactive attitudes to adaptation as well as an enhanced appreciation of the interconnectivity of processes and stakeholders operating at different scales. As explained previously, the group learning experience and dialogue within exploratory scenario development may be as important as, or even more important than, the final published scenario, enabling better understanding of stakeholder norms, values, beliefs and aspirations as well as sectoral demands and constraints. Futures techniques and the development of scenarios for coastal climate change will rely on a formative participatory process which includes not only coastal managers but a wide participatory gene pool, including civil society groups, businesses and other relevant stakeholders. Given that the business community is often not that closely involved in ICZM, and that ICZM is commonly misperceived as having an overly 'green' or environmental focus, the use of such techniques, more widely accepted within the commercial world, may bring further benefits to the ICZM process. However, the local, participatory application of futures poses some challenges, with concerns over how these approaches are introduced and developed with some local stakeholders, particularly coastal management practitioners, many of whom come from a scientific or technical rather than social science background.

Of particular note is the possibility of combining quantitative, predictive scenarios, with which ICZM practitioners and communities are generally more familiar, and qualitative exploratory scenarios, described above. Indeed, many of the IMCORE local exploratory scenarios being developed for case study sites in North West Europe are trying to incorporate the most up-to-date climate change predictions on physical climate and oceanographic system changes. However, combining quantitative and qualitative methods presents both methodological and practical challenges, with stakeholders needing to be made aware of the advantages and disadvantages of both in dealing with uncertainties. However, such multifaceted approaches clearly conform with the EC ICZM principle relating to the need for a 'combination of instruments'. Indeed, limited examples, such as that for the East Anglian coast of England (Holman *et al.* 2005a, 2005b), have shown that such multifaceted approaches offer opportunities for combining suites of methods including tools from both the natural and social sciences, to inform environmental management decision-making (Dawson *et al.* 2006; Hofmann *et al.* 2005; Holman *et al.* 2008; Kannen 2004; Watkinson *et al.* 2007). Within the IMCORE project it is anticipated that sophisticated computer Geographical Information System and web-based Virtual Reality simulations may provide an additional dimension, supplementing the textual narratives from exploratory and predictive scenarios. It is suggested that the more 'visual' IT generated visualisations may be more tangible and meaningful to some of the IMCORE participants, many of whom are more used to interpreting and using graphical rather than verbal information.

Aside from the general challenges in adopting new methods and ways of thinking, the utilisation of such techniques demands consideration of the contextual factors which are likely to influence the acceptance and effectiveness of such approaches as well as dictating the choice of scenario building approaches. These factors include the nature of coastal and ICZM governance systems, the complexity of coastal systems, the local level of application and the backgrounds of the stakeholders, many with largely natural science backgrounds, as well as the capacity of ICZM programmes to initiate, develop and utilise such techniques. With respect to governance, there are clearly major differences across Europe (Rupprecht 2006) and North West Europe (Ballinger *et al.* 2008), reflecting contrasting institutional cultures and associated value systems. As noted above, the degree to which ICZM is embedded and 'institutionalised' is variable; with differences in the extent to which 'participatory,' community-based approaches are utilised and accepted by the various communities of actors. In terms of coastal systems, some sites are clearly more challenging than others. Within North West Europe for example, the IMCORE project has realised that some of its sites, such as the Severn Estuary, not only have relatively poorly understood physical system dynamics but also have notoriously complex natural–human system interlinkages (Ballinger *et al.* 2008). With regard to local application, there are also suggestions that some areas are experiencing workshop fatigue associated with the numerous consultation processes accompanying the development of environmental plans to ensure compliance with European and national legislation and policy (Ballinger and Stojanovic 2010), a potential barrier to stakeholder engagement in participatory scenario building. In such a context, an appropriate process design, as suggested by Van Notten *et al.* (2003), is vital so as to avoid disengagement of local, practically minded stakeholders who may view the approaches as esoteric and lacking meaning to their day to day activities. However, whilst the use of integrated participatory scenario building at local scales is in its infancy (Nicholls *et al.* 2006), there are a number of generic frameworks for the development of scenario building for coastal areas (for example, Burgess *et al.* 2005; Turner 2007) which are beginning to address such issues. The limited capacity, however, of many current local ICZM programmes to use futures and scenario building techniques, particularly given their 'hand to mouth' existence, is of concern.

Further issues associated with scenario development are associated with the scale of scenarios and the need to ensure that appropriate scaling achieves the relevance and 'granularity', to be meaningful to coastal stakeholders. Adaptation, like ICZM, involves a mixture of top-down (for example, global climate research) and bottom-up elements (for example, participation of key groups and developing local capacity). Global climate change research must be reflected in each application although this must be re-calibrated for the particular profile of the coastal area in question. Such translation is, however, fraught with difficulties (Kok *et al.* 2006), although lessons may be drawn from successful attempts in the UK at 'downscaling' SRES scenarios at regional and local levels (for example, Nicholls *et al.* 2006; Holman *et al.* 2005a, 2005b; Andrews *et al.* 2005).

Conclusions

Whilst the Lisbon Agenda strives for high levels of economic growth across Europe and the EU Maritime Policy recognises the potential of Europe's maritime resources in contributing to such targets, such realisations demand fundamental shifts in the approach to addressing issues such as climate change. Facilitating the process of adaptation is a critical task for all agencies involved in coastal management, especially given the risks associated with climate change and the inappropriate siting of much existing development along the coast. With the increasing recognition of the potential impacts of climate change, building capacity to adapt to the scale and range of anticipated changes is needed within the context of existing management regimes and approaches, including ICZM, which has been widely promoted at the European level over recent years.

There is general acceptance of futures approaches for climate change adaptation and shoreline management at global, regional and even national levels and the European Environment Agency has recently devoted increasing resource to futures or forward-oriented methods. Futures present a unique opportunity to facilitate 'holistic' coastal management, which lies at the heart of ICZM, as well as the delivery of many of the key elements of ICZM and allied principles. They may also facilitate a paradigm shift in how local, regional and national governments plan for future coastal resource exploitation (Holman *et al.* 2008; Watkinson *et al.* 2007).

However, there is limited application of futures and exploratory scenarios at local levels and those applications involving local stakeholders are even rarer. This necessitates considerable utilisation of pilot projects to evaluate, demonstrate and disseminate the effectiveness of futures to the ICZM community as well as feeding into the EEA review and database of such tools (European Environment Agency 2009). In this context, a small number of initiatives, including the IMCORE project, are helping develop a better understanding of the applicability and acceptability of such techniques. This project's range of case study sites should allow evaluation of various futures techniques including exploratory scenarios to different coastal environments and governance systems. The project is also designed to illustrate the extent to which futures can assist in the formulation and implementation of adaptive management strategies for coastal resources.

Whilst the prognosis for the application of futures to coastal climate change adaptation seems rosy, there remain questions regarding the future of ICZM itself. Meanwhile, the futures literature suggests that national and regional governments, as appropriate, should pay adequate attention to local capacity in order to design and deliver futures' processes and outputs and to ensure that the learning process is distributed through the local and regional context. Given the current fragile status of ICZM in northern Member States, are local ICZM programmes likely to experiment with such techniques when their very own future is at risk? Clearly, considerable support for ICZM, including resources and enhanced legal status, may be essential to ensure that both ICZM and futures can develop in parallel to foster long-term sustainability of coastal systems.

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